X.—*Table shewing the Weight or Pressure which a cylindrical wrought-iron Bolt will sustain when supported at the ends, and bonded in the middle of its Length. By Captain* J. THOMSON, *Engineers.*

Leng. of bearg.	In. ¼	In. ½	In. ¾	In. 1	Ins. 1¼	Ins. 1½	Ins. ¾	Ins. 2	Ins. 3	Ins. 4	Ins. 6	Ins. 8	Ins. 10	Ins. 12
Wt. in Tons.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. In.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.	Dm. Ins.
2	·57	·72	1·82	·9	·97	1·03	1·09	1·14	1·3	1·44	1·64	1·8	1·95	2·06
4	·72	·9	1·03	1·14	1·23	1·3	1·37	1·44	1·64	1·8	2·06	2·28	2·46	2·6
6	1· *	1·03	1·18	1·3	1·4	1·49	1·57	1·64	1·88	2·06	2·36	2·6	2·81	2·98
8	1·33	1·14	1·3	1'43	1·54	1·64	1·75	1·8	2·07	2.28	2·6	2·86	3·09	3·28
12	2·	1·3	1·49	1·64	1·27	1·88	1·98	2·06	2·37	2·6	2·98	3·28	3·54	3.7
16	2·66	1·43	1·64	1·81	1·95	2·07	2·18	2·28	2·61	2·86	3·28	3·62	3·90	4·14
20	3·33	1*66	1·77	1·95	2·1	2·23	2·35	2·46	2·81	3·1	3·54	3·90	4·20	4·46
24	4·	2·	1·88	2·07	2·23	2·37	2·49	2·61	2·98	3·28	3·76	4·14	4·46	4·74
28	....	2·33	1·98	2·18	2·35	2·49	2·63	2·75	3·15	3·46	3·96	4·36	4·70	4·98
32	....	2·66	2·07	2·28	2·45	2·61	2·75	2·87	3·29	3·62	4·14	4·56	4·91	5·22
40	....	3·33	2·23	2·46	2·64	2·81	2·96	3·09	3·54	3·9	4·46	4·92	5·29	5·62
48	....	4·	2·*5	2.61	2·81	2·98	3·15	3·29	3·76	4·14	4·74	5·22	5·62	5·96
56	....	....	3·11	2·75	2·96	3·14	3·31	3·46	3·96	4·36	4·98	5·50	5·92	6·28
64	....	....	3·55	2·87	3·09	3·28	3·46	3·62	4·14	4·56	5·22	5·74	6·19	6·56
72	....	....	4.	3· *	3·21	3·42	3'60	3·76	4·30	4·74	5·42	5·96	6·43	6·84
80	....	....	....	3·33	3·33	3·54	3·73	3·9	4·46	4·91	5·62	6·18	6·67	7·08
88	....	....	....	3·66	3·44	3·65	3·85	4·02	4·60	5·07	5·8	6·38	6·88	7·30
96	....	....	....	4.	3·54	3·76	3·96	4·14	4·74	5·22	5·96	6·58	7·08	7·52
104	....	....	....	....	3·63	3·86	4·07	4·25	4·87	5·36	6·14	6·74	7·27	7·72
112	....	....	....	....	3·72	3·96	4·17	4·36	4·99	5·49	6·28	6·92	7·45	7·92
120	....	....	....	....	4·*	4·05	4-26	4·46	5·11	5·62	6·44	7·08	7·63	8·10
128	....	....	....	.. .	4·3	4·14	4·36	4·56	5·21	5·74	6·56	7.24	7·8	8·28

Observations on the foregoing Table.

There are two ways in which the bolt may be broken, either by a cross strain, or by detrusion, which is the pulling out the part of the bolt from between the points of support: besides these two ways in which the fastening may be broken, the bolt may crush and cut away the eye of the link which presses upon it.

‡ If w=weight or pressure in tons,

l=length of the bolt between the points of support in inches,

d=diameter of the bolt in inches, then $d=(.37\ w\ l)^{\frac{1}{3}}$ to support a cross strain; but when l becomes less than $\left(\frac{w}{267}\right)^{\frac{1}{2}}$ the bolt will be liable to detrusion, to avoid which, $d=(.08\ w)^{\frac{1}{2}}$. But detrusion can never take place when both the bolt and the link are formed of iron, or the same metal, because when l becomes less than $\left(\frac{w}{71.5}\right)^{\frac{1}{2}}$ the link may be cut by the bolt; to obviate which, the value of d should be $=\frac{w}{24\ l.}$ This last equation supersedes the first

‡ These rules are taken from TREDGOLD, the arbitrary quantities assumed by him being corrected by a comparison made, and a mean, taken from the best authorities.

when $w=71.5\,l^2$. This place is marked * in the table.

Remarks on keys, hold-fasts, &c.

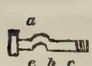
Put b=the breadth in inches,
d=the depth in inches,
w=weight in tons,
l=length of bearing in inches; then the breadth should never be made less than $\frac{w}{24\,l}$, and the section $bd^2=.37\,w\,l$, or $d=\left(\frac{.37\,wl}{b}\right)^{\frac{1}{2}}$.

As an example, suppose a bar 1 inch square to support 8 tons was fastened by a key; required the breadth and depth?

$$w=8.\text{—}l=1 \text{ and } \frac{w}{24\,l}=\frac{\quad}{24}=\frac{1}{3}=b \text{ or the breadth required,}$$

$$\therefore d=\left(\frac{.37w\,l}{b}\right)^{\frac{1}{2}}=\sqrt{8.88}=2{\cdot}98 \text{ inches, the depth required.}$$

To support the accuracy of this table, a set of experiments was commenced, but the results from them were so unsatisfactory, that they were not continued. But during the proof of three bridges in which bolts of from $1\frac{1}{4}$ in. to $2\frac{1}{4}$ in. were used, with various lengths of bearing, and pressures of from 20 to 15 tons, the dimensions marked in the table were found sufficiently strong in every instance; but the diameter of the bolt thus given could not be reduced much, or what was the same thing, the length of bearing could not be decreased without a risk of failure.



The best Swedish iron bolts did not sustain a greater pressure than the ordinary English bolt iron, (rolled, not hammered.) The Swedish iron when strained in excess bent, and became dented as in the marginal figure: the side *a* was bulged or rose half as much as *b* was indented or bent, on the other side; when the bolts were formed of English bolt iron (unhammered), numerous cracks opened on the convex surface of the bolts at *a* and *c c*, when the indentation at *b* amounted to $\frac{1}{16}$ of the diameter of the bolt; the bolt failed by these cracks meeting each other, and the centre part of the bolt was drawn out.

The bars, which these bolts connected, were calculated to sustain 9 tons per square inch of section, and the eyes 7 tons, but when the whole were proved by a tension $\frac{1}{3}$rd greater than the calculated strength, the eyes broke more frequently than either the bars or bolts.

The following table, for which we are also indebted to Captain J. THOMSON, Engineers, will serve as a practical continuation of the observations on roofing, in the last number of the Journal.